them in their true relations. The dissected highland of fig. 116, with the broad cone of detritus forming the only habitable region at its foot, will remind the traveller of the valley of the Inn or of the Drau. The volcanic relics in fig. 132 explain Gergovia and Mont Dore. The eighth chapter, on "Der aride Zyklus," appeals strongly to pioneers on the edges of our colonised lands, and would have edified the Roman senate, when it republished the Carthaginian text-books and faced the problems of the desert and the steppes. On pp. 375–6 the evidence for a recent uplift of central and southern Africa is well stated. A characteristic discussion on the methods of presenting geographical problems finds its way somehow into this chapter. British geologists will turn with interest to the chapters on glacial conditions and marine erosion. The explanation of the features of the coast of south Devon on p. 502, which seems at first somewhat complex, is fully justified when we realise that the "soft rocks" postulated really exist in the form of Cretaceous and perhaps Eocene limestones beneath the English Channel.

The disguise of Prof. Davis as a Prussian is a thin one. Who does not recognise him in the brilliant description of the Roman area on pp. 393–4, which is to occupy four minutes of oral instruction; or in the terrifying discovery on p. 398 that every land-form can be treated geographically in four-and-fifty different ways?

GRENVILLE A. J. COLE.

OUR BOOKSHELF.

The Manufacture of Iron and Steel: a Handbook for Engineering Students, Merchants, and Users of Iron and Steel. By H. R. Hearson. Pp. xi + 103. (London: E. and F. N. Spon, Ltd., 1912.) Price 4*s*. 6*d*. net.

THIS small volume is obviously primarily intended to give engineering students an outline of the manufacturing operations of iron and steel, and also an idea of the chemical characteristics and the mechanical properties of the finished products. The author has undoubtedly, to a great extent, produced a lucid and useful little text-book.

After a preliminary chapter on elements, the blast furnace is considered, being followed by a short chapter on wrought iron. Steel is next dealt with, including the Bessemer, Crucible, and Siemens methods. The book has so much valuable and accurate information that it may be of very great use to elementary students of iron and steel metallurgy, but several remarkable errors should be revised in any future edition. For instance, on page 37, steel containing 0·3 per cent. of carbon is classified as medium instead of mild, and steel containing 0·7 per cent. of carbon is designated hard instead of medium. In describing the manufacture of "blister steel" by cementation, the author states, "None of the bars is carburised right through to the centre, so the centre still remains as iron." This is true of, say, No. 2 bars, but high-number bars are always "steel through." Some of the paragraphs on crucible steel also need serious revision; for instance, the curious assertion that if kept too long in the furnace the steel will become brittle by taking up too much silicon from the crucible. Mr. Hearson also revives the obsolete dictum that mild steel is crystalline and wrought iron fibrous. On page 77 the somewhat astounding information is given that the top of an ingot may be prevented from rapidly solidifying by covering the top with sand. The chapter on the mechanical testing of steel is excellent, but in the brief final chapter dealing with the heat treatment of steel many metallurgists will be surprised to learn that steel containing 0·25 per cent. of carbon becomes "hard" on quenching, and the paragraphs on hardening are out of date. If carefully revised, however, the book will become of distinct value. J. O. A.

Photochemische Versuchstechnik. By Dr. Johannes Plotnikow. Pp. xv + 371. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1912.) Price 11 marks.

THIS book forms the complement of a previous volume by Dr. Plotnikow on the theory of photochemistry ("Photochemie," W. Knapp in Halle a.S., 1910). In the present work he describes at length the apparatus and the experimental methods used in photochemical research. Part i. contains a useful summary of the characteristics of the various sources of light that may be employed. The mercury arc lamp, in which a steady electric current is passed through the vapour of mercury in a highly exhausted tube of Uviol glass or of fused quartz, is recommended as providing a constant and trustworthy source. Other sources discussed are the arc and spark between metal terminals, the carbon arc, the Nernst lamp, and the Röntgen ray tube. In part ii. Dr. Plotnikow describes the construction of the special forms of thermostat which he has devised for photochemical experiments, and enumerates a number of solutions that may be employed as light filters with the mercury vapour lamp in order to give approximately monochromatic light.

Part iii. contains an account of the instruments used in optical measurements, including photometers, spectrophotometers, spectrometers, refractometers, and polarimeters.

In part iv. the author describes a number of interesting lecture experiments for illustrating the fundamental laws of photochemical reactions, the various phenomena of luminescence, and the principal facts of photoelectricity. It is satisfactory to find attention directed to the subject last named, since the separation of negative electrons under the influence of light probably forms the clue to the understanding of the mechanism of all photochemical processes.

Part v. contains a collection of tables likely

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to be useful in photochemical work. The values of the function e^{-x} are tabulated in thirteen pages from $x = o$ to $x = 10$, and fifty-six pages are assigned to tables by Dr. N. Rosanow showing the reciprocal of the wave length and the frequency for every Ångström unit from λ 2000 to λ 8000.

H. S. A.

The Economics of Everyday Life. Part i. By T. H. Penson. Pp. xiv + 174. (Cambridge University Press, 1913.) Price 3*s.* net.

IT is surprising how difficult it apparently is to write a good short text-book of economics, but Mr. Penson has been eminently successful in doing so. He has fully grasped the fact that the first need for such a book is to be simple and elementary as well as short. Where possible, he rightly prefers the ordinary terms of everyday use to the technical phrases of economics. For instance, instead of production, exchange and distribution, he talks of the "source of income," "buying and selling," and the "individual income." These, in my opinion, are far more intelligible to the beginner. Moreover, his definitions are nearly always both clear and adequate, those of demand and supply affording a good example.

The method of treatment follows, on the whole, that of the modern school, of which Prof. Marshall may be regarded as the head, and exchange is treated before, and not after, distribution. The subjects of consumption, taxation, trade unions and cooperative societies are left to the second part of this book, which has yet to be published.

The present volume clearly marks Mr. Penson as possessing great capacity as a teacher. He chooses wisely not only his terms, but the subjects of which he treats. Omitting nothing that is essential, he has avoided thorny and difficult subjects likely to confuse the beginner. His definitions, too, are both concise and complete. A new and valuable feature of the book is found in the simple tables and diagrams by which the argument is rendered easy to understand, but mathematical methods are rigidly, and in such a book rightly, avoided. Occasionally, however, the author treats unimportant matters somewhat too fully. Usually he is neither too long nor too short, but, like Sidney Godolphin, "is never in the way, and never out of it."

N. B. DEARLE.

Dent's Practical Notebooks of Regional Geography. By H. Piggott and R. J. Finch. Book i., The Americas. Pp. 64. (London: J. M. Dent and Sons, Ltd., 1913.) Price 6*d.* net.

IF every geography teacher set the same practical exercises, this conveniently arranged notebook would have a wide circulation; but naturally a teacher's exercises should reflect his own individuality. The little book may be commended, however, as affording a good example of the way in which pupils can be led to acquire an intelligent knowledge of geography as the result of their own activities.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

An Application of Mathematics to Law.

I HAVE attempted to apply mathematical symbolism to some of the difficult problems of patent law. The question to be decided by the Court in a patent law suit is usually this: assuming that the alleged invention deals with "a manner of manufacture" (*i.e.* is, or yields, something concrete), was there ingenuity and utility in the step from what was already known? Ingenuity means inventive or creative ingenuity as apart from the normal dexterity of the craftsman, which of itself is insufficient to support a patent, as otherwise patents would unduly hamper industry. It will be seen at once that it is a most subtle question for any court to determine whether a given act, the selection of one out of many alternatives, the assemblage of various old elements, the adaptation of old elements to new uses—whether such an act is one which calls for ingenuity as apart from the expected skill of the craftsman.

To express the problem symbolically I will start from an admirable dictum of Lord Justice Fletcher Moulton (Hickton Pat. Syn. *v.* Patents Improvements). He stated that invention might reside in the idea, or in the way of carrying it out, or in both; but if there was invention in the idea plus the way of carrying it out, then there was good subject-matter for a patent. I express this by representing any idea as a functional operator, and the way of carrying it out (*i.e.* the concrete materials adopted) as a variable. Calling result I:

$$I = f(x).$$

Here I represents what the Germans call the "technical effect" of the invention, or what Frost calls the manufacturing "art," and we see at once that a patent cannot be obtained for a mere principle or idea (f, which is not concrete) unless some way of carrying it out (x) is also given. But the invention may reside either in f or in x.

Let us express in general terms a manufacture (M) which is not an invention. We will use f to represent a known operator or idea, ϕ to represent a new operator or idea. a, b . . . will represent known variables, ways of carrying out an invention (*e.g.*, valves, chemical substances, &c.), and x, y, new variables.

It is obvious that $f(a)$ is not an invention, nor will it normally be an invention to add $f(b)$ to it. Moreover, the craftsman is not to be tied down to this. He is at perfect liberty, within limits, to make variations in his variables, to alter the size of a crank, to substitute one alkali for another, and so on; in other words, he can take $f(a + \delta a)$.

Generalising, we may say:

$$M = \Sigma f(a + \delta a).$$

Developing this by Taylor's theorem, and proceeding from an infinitesimal to a finite change, we have, neglecting quantities of the second order:

$$M = \Sigma f(a) + \Sigma \delta f(a).$$

This is the general equation for a manufacture which is not an invention. To be an invention, ingenuity (i) must be involved.

$$I = M + i \text{ or } I = \psi(M),$$

thus:

$$I = \psi[\Sigma f(a) + \Sigma \delta f(a)] = \Sigma f(a) + \Sigma \delta f(a) + i.$$

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